The majority of the partial correlation coefficients among yield components were low and positive in sign (Table 1). Only three significant negative correlations among yield components were observed in a total of 40 correlation coefficients. These results indicate that separate genetic systems control the different yield components and that it should be possible to develop bean lines from crosses of these indeterminate parents which would have a higher value of one component without producing much of a reduction in the other components.

Partial phenotypic correlation coefficients between each component of yield and total seed yield, with the other components held constant, indicated that all of the components contributed about equally to total seed yield except in the F_2 G.N. Nebraska #1 x Dark Red Kidney and G.N. Nebraska #1 x Yellow Eye 209806. In these populations seed weight and number of seeds per pod showed low partial correlation coefficients with total seed yield.

Table 1. Partial correlation coefficients between number of pods per plant, number of seeds per pod, and mean seed weight in parental and derived generations of field bean crosses at Lincoln.

Year	Generation	Pods per plant with seed wt	Seed wt with seed per pod	Pods per plant with seed per pod	Degrees of freedom
1966	G.N. 1140 (P_1)	-0.12	0.68**	0.19	54
"	PI 165078 (P_2)	0.81**	0.33*	0.36*	41
"	F_1	0.41**	-0.19	0.49**	49
"	F_2	0.23*	0.43**	0.25**	217
"	P_1 x F_1	-0.33**	0.22	0.13	54
"	P_2 x F_1	0.53**	-0.36	0.57**	22
1962	Dark Red Kidney (P_1)	0.01	-0.50*	0.08	19
"	G.N. Nebraska #1 (P_2)	0.04	0.08	0.08	16
"	F_2	0.07	-0.33**	0.10	61
1962	Yellow Eye PI 209806 (P_1)	0.04	-0.18	-0.19	16
"	G.N. Nebraska #1 (P_2)	0.24	0.32	0.10	16
"	F_2	0.04	-0.15	0.10	215

* Significant at the 5% P level.
**Significant at the 1% P level.

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Heritability and Selection of Yield Components in Beans

Dermot P. Coyne
University of Nebraska, Lincoln, Nebraska

The late-maturing field bean PI 165078 was found to be highly tolerant to bacterial wilt and had a large seed size (Proc. Amer. Soc. Hort. Sci. 87, 1965). This PI line was crossed to the early-maturing G.N. 1140 variety to combine early maturity, large seed size, and disease resistance in a G.N. type bean. It was of interest to study heritability of total seed yield and each of the three yield components in this cross. The three yield components are number of pods per plant, number of seeds per pod and mean seed weight. If one yield component was found to be more highly heritable than total seed yield itself, and if a high correlation coefficient existed between these traits, it might be possible to increase total seed yield by selecting one particular component.

In 1966, 70 plants were selected at random from the (219 plants) F_2 G.N. 1140 x PI 165078. Also, the top 5% of this F_2 was selected separately for total seed yield, and each of the three yield components. These populations were grown in replicated experiments in 1967. Heritability estimates for yield and components of yield was calculated by regression of F_3 progeny means (1967) on individual F_2 plant values (1966). Low heritability estimates were obtained for total yield and each component of yield and no yield improvement was realized through selection. No progress was achieved through selection because of the large environmental effect on the expression of these traits making it difficult to identify genetically superior individuals, and also the additive genetic variance was probably low in this population. It is suggested that bulk population breeding would be more efficient and productive breeding procedure in selecting for higher yields in populations derived from this cross than the pedigree method. Physiological factors which were found to be associated with high yield by other workers may not be useful in the identification of genotypically superior yielding segregates in the field because these traits would be quantitatively inherited like yield components and subject to large variations due to environment. It would seem more desirable to identify varieties which possess one or more of these physiological factors and then to intercross these types in order to possibly obtain some favorable gene recombinations for these different yield factors. A bulk population breeding system could then be adopted as mentioned previously.

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Breeding Behavior of a Variegated Mutant in Green Beans

Dermot P. Coyne
University of Nebraska, Lincoln, Nebraska

Some plant species possessing variegated foliage are desirable for ornamental purposes. However, in crop plants some types of variegation cause a stunting and a distortion of growth. In some cases, it has been a difficult problem to eliminate this rogue from seed stocks.

Different types have been reported by several workers. Coyne (Crop Sci. 6, 1966 and J. Hered. 58, 1967) found variegated segregates in some P. vulgaris crosses. The development of these types was explained on a two-element control system, one gene being unstable in the presence of a mutator gene.

The type of variegated mutant reported here was found by Dr. R. Goth (U.S.D.A., Beltsville, Maryland) in Stringless Green Refugee. This mutant was crossed to another variegated type (Crop Sci. 6:307-310). The reciprocal F_1 between the two mutants showed good complementation indicating that these two types were controlled by different genetic systems.

The seedlings of the Stringless Green Refugee mutant appear normal but later-formed trifoliate leaves are severely variegated, crinked and distorted.